Amendments to the Specification

1) Please insert the following subtitle at page 1, below the title:
Background

2) Please insert the following subtitle at page 1, line 33:
Summary

3) Please delete the text at page 3, lines 11 – 26.

4) Please delete the text beginning at page 4, line 26, and ending at page 5, line 3.

5) Please replace the paragraph at page 5, line 6, with the following:

In the example shown in ~~figure~~ Figure 1, a double air separation column comprises a medium-pressure column K01 and a low-pressure column K02 that are thermally coupled by means of a principal vaporizer E02 that is used to condense at least part of the gaseous overhead nitrogen of the column K01 by heat exchange with oxygen from the bottom of the column K02.

6) Please insert the following subtitle and text at page 5, line 6:
Brief Description of the Drawings

For a further understanding of the nature and objects for the present invention, reference should be made to the following detailed description, taken in conjunction with the accompanying drawings, in which like elements are given the same or analogous reference numbers and wherein:

- Figure 1 illustrates a first schematic representation of one embodiment according to the current invention;
- Figure 2 illustrates a second schematic representation of another embodiment according to the current invention;
- Figure 3 illustrates a schematic representation of a modification to the embodiment shown in Figure 1;
- Figure 4 illustrates a third schematic representation of an embodiment according to the current invention;
- Figure 5 illustrates a schematic representation of a modification to the embodiment shown in Figure 3;
- Figure 6 illustrates a schematic representation of a modification to the embodiment shown in Figure 4;

- Figure 7 illustrates a schematic representation of a modification to the embodiment shown in Figure 5;
- Figure 8 illustrates fourth schematic representation of an embodiment according to the current invention; and
- Figure 9 illustrates a fifth schematic representation of an embodiment according to the current invention.

7) Please insert the following subtitle and text after the above-inserted paragraphs:

Description of Preferred Embodiments

One object of the present invention is to propose systems for increasing the krypton and xenon yield of units producing gaseous oxygen by pumping and vaporization of liquid oxygen (or more generally those with substantial withdrawal of liquid oxygen from the bottom of the low-pressure column) and, preferably, also producing argon.

Another object of the present invention is again to have a principal vaporizer with a high oxygen content and massively purged, and thus to greatly limit the concentration of hydrocarbons/impurities (the advantage of a pumped "oxytonne"), which is not the case with the conventional scheme producing a weak mixture of krypton and xenon.

One subject of the invention is a method for producing oxygen and rare gases by distillation in a column system comprising at least one medium-pressure column, one low-pressure column and one auxiliary column, in which method:

i) at least one stream of cooled and purified air is sent to the medium-pressure column where it is separated;

ii) at least a first nitrogen-enriched stream is withdrawn from the medium-pressure column and at least one portion of this stream is sent directly or indirectly to the low-pressure column;

iii) an intermediate stream is withdrawn from an intermediate level of the medium-pressure column;

iv) a stream, enriched with oxygen relative to the intermediate stream, is withdrawn from the bottom of the medium-pressure column and sent to the bottom of the auxiliary column;

v) a nitrogen-rich stream is withdrawn from the top of the low-pressure column;

vi) an oxygen-rich liquid stream is withdrawn from the low-pressure

column as product, optionally after a vaporization step in order to form a gaseous product; and

vii) an oxygen-enriched stream, which is also enriched with krypton and with xenon relative to the second oxygen-enriched stream, is withdrawn from the auxiliary column,

characterized in that the intermediate stream is sent to the low-pressure column and a liquid stream containing at least 78 mol% nitrogen is sent as reflux to the auxiliary column.

Preferably, the liquid stream sent as reflux to the auxiliary column is liquefied air and/or liquid enriched with nitrogen relative to a liquefied air stream sent to the medium-pressure column.

According to optional aspects:

- the bottom of the auxiliary column is heated by an overhead gas from an argon column;
- the liquefied air and/or the liquid enriched with nitrogen relative to the air is produced by heat exchange with the oxygen-rich liquid stream coming from the bottom of the low-pressure column, optionally after a pressurization step;
- the nitrogen-enriched liquid contains at least 80 mol% nitrogen;
- the liquefied air does not come from the medium-pressure column, the liquid stream sent to the top of the auxiliary column is richer in nitrogen than the intermediate stream; at least 10% of the oxygen produced is withdrawn in liquid form from the low-pressure column.

Another subject of the invention is a plant for producing oxygen and rare gases by distillation in a column system comprising at least one medium-pressure column, one low-pressure column and one auxiliary column, which plant comprises:

i) means for sending at least one stream of cooled and purified air to the medium-pressure column where it is separated;

ii) means for withdrawing at least a first nitrogen-enriched stream from the medium-pressure column and means for sending at least one portion of this stream directly or indirectly to the low-pressure column;

iii) means for withdrawing a nitrogen-rich stream from the top of the

low-pressure column;

iv) means for withdrawing an intermediate stream from an intermediate level of the medium-pressure column;

v) means for sending a stream, richer in oxygen than the intermediate stream, from the bottom of medium-pressure column into the bottom of the auxiliary column;

vi) means for sending a liquid stream as reflux to the auxiliary column;

vii) means for withdrawing an oxygen-rich liquid stream from the bottom of the low-pressure column as product, optionally after a vaporization step in order to form a gaseous product; and

viii) means for withdrawing a third oxygen-enriched stream, which is also enriched with krypton and with xenon relative to the second oxygen-enriched stream, from the auxiliary column,

characterized in that it includes means for sending, as reflux stream to the auxiliary column, liquefied air or a liquid stream enriched with nitrogen relative to a liquid air stream sent to the medium-pressure column.

According to other optional aspects, the plant includes:

- a purification column, means for sending the third oxygen-enriched stream into the top of the purification column and means for withdrawing a fourth oxygen-enriched stream, constituting a mixture enriched with krypton and xenon, at least a few theoretical stages lower down in the column; and
- an exchange line in which the liquefied air and/or the liquid enriched with nitrogen relative to the air is produced by heat exchange with the oxygen-rich liquid stream coming from the bottom of the low-pressure column, optionally after a pressurization step.

8) Please replace the paragraph at page 7, line 20, with the following:

In the following figures, various alternative embodiments deriving from ~~figure~~ Figure 1 will be presented. The elements common with ~~figure~~ Figure 1 will not be described a second time.

9) Please replace the paragraph at page 7, line 25, with the following:

In the case of ~~figure~~ Figure 2, all of the liquid air LIQ AIR coming from the main exchange line is sent into the column K01. An intermediate fluid in liquid

form 1' is withdrawn from the column K01 (preferably at the level where the liquid air is introduced or at a level above this level). Next, after having been subcooled, it is distributed between the column K02 and the column K05 as two streams 3 and 5. Stream 11 containing at least 80 mol% nitrogen is sent to the top of the column K05.

10) Please replace the paragraph at page 7, line 35, with the following:

In the case of ~~figure~~ Figure 3, based on ~~figure~~ Figure 1, one top section of the column K05 has been removed. The reflux from this column is provided only by liquid air 5, preferably subcooled. This liquid air is produced by vaporization of the liquid oxygen LO pumped and vaporized in the exchange line. All the lean liquid 13 is sent to the low-pressure column K02.

11) Please replace the paragraph at page 8, line 4, with the following:

In addition, all of the liquid air LIQ AIR present at the outlet of the exchange line can be withdrawn from the column K01 (preferably at the point of introduction of the liquid air) and then distributed between the column K02 and the column K05 after having been subcooled, as shown in ~~figure~~ Figure 4.

12) Please replace the paragraph at page 8, line 11, with the following:

In the case of ~~figures~~ Figures 5 and 6, based on ~~figures~~ Figures 3 and 4, the waste gas WN2' from the column K05 is sent back into the column K02 below the point of injection of the lean liquid 13.

13) Please replace the paragraph at page 8, line 16, with the following:

In the case of ~~figure~~ Figure 7, based on ~~figure~~ Figure 5, the stream 16 is omitted and replaced with a stream of waste nitrogen WN2' sent from the top of the auxiliary column K05 to an intermediate point on the low-pressure column.

14) Please replace the paragraph at page 8, line 22, with the following:

In all the figures described above (~~figures~~ Figures 1 to 7), it is possible to couple the plant with the conventional scheme for producing krypton and xenon. To do this, it is necessary to install stages for enrichment of the bottom in the column K02. The liquid oxygen LO is produced a few stages above the principal vaporizer E02. A purge 21 is withdrawn level with the principal vaporizer E02. It contains about 70 mol% krypton and all of the xenon present in the column K02. It is sent to the column K90 in order to recover the rare gases.

15) Please replace the paragraph at page 8, line 33, with the following:

An example is given in ~~figure~~ Figure 8.

16) Please replace the paragraph at page 8, line 35, with the following:

In all the above figures (~~figures~~ Figures 1 to 8), the coproduction of argon is mentioned. However, it is possible to fit the plants described above to a unit that does not produce argon. For example, it is sufficient to install an exchanger for condensing a fraction of the gas 7 withdrawn from the column K02. Once liquefied, it is sent (9) into the column K02. This thus provides the reboiling in the column K05.

17) Please replace the paragraph at page 9, line 5, with the following:

An example is given in ~~figure~~ Figure 9.

18) Please insert the following paragraph at page 9, line 33:

It will be understood that many additional changes in the details, materials, steps and arrangement of parts, which have been herein described in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims. Thus, the present invention is not intended to be limited to the specific embodiments in the examples given above.

19) Please replace the paragraph at page 9, line 11, with the following:

In addition, the schemes illustrated in ~~figures~~ Figures 1 to 9 may also include distillation assemblies, such as for example an Etienne column (a column that operates at an intermediate pressure between the medium and low pressures and fed with rich liquid). In this case, it is possible to modify the top condenser of an Etienne column, by replacing the argon column K10 of ~~figures~~ Figures 1 to 9 with an Etienne column according to the same principle: addition of stages above the condenser in order to concentrate the rare gases.

20) Please replace the subtitle at page 10, line 1, with the following text:

~~Claims~~ What is claimed is:

Amendments to the Claims

This listing of claims will replace the originally filed claims in the application.

Listing of Claims:

Claims 1 – 12 (canceled).

Claim 13 (new): A method which may be used producing oxygen and rare gases by distillation, said method comprising:

a) separating at least one stream of cooled and purified air in a medium pressure column;
b) withdrawing at least a first nitrogen enriched stream from said medium pressure column;
c) sending at least part of said first nitrogen enriched stream to a low pressure column;
d) withdrawing an intermediate stream from an intermediate level of said medium pressure column;
e) withdrawing a first oxygen enriched stream from the bottom of said medium pressure column, wherein said first oxygen enriched stream is richer in oxygen than said intermediate stream;
f) sending said first oxygen enriched stream to the bottom of at least one auxiliary column;
g) withdrawing a second nitrogen rich stream from the top of said low pressure column;
h) withdrawing a second oxygen rich liquid stream from said low pressure column;
i) withdrawing a third oxygen enriched stream from said auxiliary column, wherein said third oxygen enriched stream is also enriched with xenon and krypton as compared to said second oxygen rich stream;
j) sending said intermediate stream to said low pressure column; and
k) sending at least one liquid reflux stream to said auxiliary column, wherein said reflux stream comprises about 78 mol % nitrogen.

Claim 14 (new): The method of claim 13, further comprising vaporizing said second oxygen rich liquid stream to obtain a gaseous product.

Claim 15 (new): The method of claim 13, further comprising indirectly sending at least part of said first nitrogen enriched stream to said low pressure column.

Claim 16 (new): The method of claim 13, further comprising:

a) sending said third oxygen enriched stream to the top of a purification column; and

b) withdrawing a final oxygen enriched stream from a final location on said purification column, wherein:

1) said final oxygen enriched stream comprises a mixture enriched with krypton and xenon; and

2) said final location is at least about three theoretical stages down from the top of said purification column.

Claim 17 (new): The method of claim 13, wherein said liquid reflux stream comprises at least one member selected from the group consisting of:

a) liquefied air; and

b) a liquid stream richer in nitrogen than a liquid air stream which is sent to said medium pressure column.

Claim 18 (new): The method of claim 13, wherein the bottom of said auxiliary column is heated by an overhead gas from an argon column.

Claim 19 (new): The method of claim 17, further comprising producing said liquid reflux stream by heat exchange with said second oxygen rich liquid stream.

Claim 20 (new): The method of claim 19, wherein said heat exchange takes place after a pressurization step.

Claim 21 (new): The method of claim 17, wherein said reflux stream comprises at least about 80 mol % nitrogen.

Claim 22 (new): The method of claim 17, wherein said liquefied air does not originate from said medium pressure column.

Claim 23 (new): The method of claim 13, wherein said reflux stream is richer in nitrogen than said intermediate stream.

Claim 24 (new): The method of claim 13, further comprising withdrawing at least about 10% of all the oxygen produced by said method from said low pressure column.

Claim 25 (new): An apparatus which may be used for producing oxygen and rare gases by distillation, said apparatus comprising:

a) at least one medium pressure column;

b) a low pressure column;

c) an auxiliary column;

d) a first distribution means for sending at least one stream of cooled and purified air to said medium pressure column, wherein said cooled and purified stream is then separated;

e) a first withdrawing means for withdrawing at least a first nitrogen enriched stream from said medium pressure column;

f) a second distribution means for sending at least a portion of said first nitrogen enriched stream to said low pressure column;

g) a second withdrawing means for withdrawing a second nitrogen rich stream from the top of said low pressure column;

h) a third withdrawing means for withdrawing an intermediate stream from an intermediate level of said medium pressure column;

i) a third distribution means for sending a first oxygen enriched stream from said medium pressure column to said auxiliary column, wherein said first oxygen enriched stream is richer in oxygen than said intermediate stream;

j) a fourth distribution means for sending a liquid reflux stream to said auxiliary column;

k) a fourth withdrawing means for withdrawing a second oxygen rich stream from the bottom of said low pressure column, wherein said second oxygen rich stream is withdrawn as a liquid and is suitable for use as product;

l) a fifth withdrawing means for withdrawing a third oxygen enriched stream from said auxiliary column, wherein:

1) said third oxygen enriched stream is richer in krypton and xenon than said second oxygen rich stream; and

2) said fifth withdrawing means comprises a fifth distribution means for sending a second reflux stream to said auxiliary column, wherein said second reflux stream comprises at least one member selected from the group consisting of:

i) liquefied air; and

ii) a liquid stream richer in nitrogen than a liquid air stream which is sent to said medium pressure column.

Claim 26 (new): The apparatus of claim 25, wherein said second oxygen rich liquid stream is vaporized prior to withdrawal in order to obtain a gaseous product.

Claim 27 (new): The apparatus of claim 25, wherein said second distribution means indirectly sends at least a portion of said first nitrogen enriched stream to said low pressure column.

Claim 28 (new): The apparatus of claim 25, further comprising:

a) a purification column;

b) a purification distribution means for sending said third oxygen enriched stream into the top of said purification column;

c) a purification withdraw means for withdrawing a final oxygen enriched stream, wherein:

1) said final oxygen enriched stream comprises a mixture enriched with krypton and xenon; and

2) said final oxygen enriched stream is withdrawn at least about three theoretical stages down from the top of said purification column.

Claim 29 (new): The apparatus of claim 25, further comprising an exchange line, wherein said second reflux stream is produced in said exchange line by heat exchange with fourth oxygen rich stream.

Claim 30 (new): The apparatus of claim 29, wherein said second reflux stream is produced after a pressurization step.